NON-PUBLIC?: N
ACCESSION #: 9012280292
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Sequoyah Nuclear Plant, Unit 2 PAGE: 1 OF 7

DOCKET NUMBER: 05000328

TITLE: Reactor trip caused by low-pressurizer pressure resulting from operator actions upon loss of a reactor coolant pump.
EVENT DATE: 11/23/90 LER #: 90-017-00 REPORT DATE: 12/21/90

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 010

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On November 23, 1990, at 0431 Eastern standard time with Unit 2 in Mode 1, a reactor trip occurred as a result of low-pressurizer pressure. Two minutes earlier, the 6.9kV Unit Board 2D had deenergized, leading to the loss of the No. 4 reactor coolant pump (RCP). The loss of the unit board has been determined to have been caused by sticking contacts on the fast transfer 62-224 relay. When the RCP tripped, Operations' personnel immediately began to take action to reduce power. The shift operating supervisor began searching for a procedure covering the loss of an RCP. Operations' personnel did not assume their normally assigned task, and they did not communicate effectively with one another while performing the tasks they assumed. The lead reactor operator (LRO) manually began reducing power faster than the turbine was being run back because of a perceived urgency to shut the unit down; this resulted in a power mismatch, the average temperature and reference temperature and,

subsequently, low-pressurizer pressure. The cause of the reactor trip was a misunderstanding of the consequences of losing one RCP below 35 percent power by the LRO, and subsequent poor communication and command and control by Operations' personnel.

END OF ABSTRACT

Description of Event

On November 23, 1990, at 0429 Eastern standard time (EST), with Unit 2 in Mode 1 (30 percent reactor power, 24 percent turbine power, 2235 pounds per square inch gage psig! and 554 degrees Fahrenheit F!), the Unit 2 balance of plant (BOP) operator had completed transfer of all unit two 6.9 kilovolt (kV) unit boards (EIIS Code ECBD) from alternate feeder to normal feeder using General Operating Instruction 2, "Plant Startup From Hot Standby to Minimum Load." When the automatic and manual Selector Switch XS-57-79 on 2D was placed in the automatic position, the normal feeder breaker opened. The alternate feeder instantaneously closed and reopened, causing a loss of voltage.

At the time unit board 2D deenergized, the shift operating supervisor (SOS) was standing in front of Control Panel M-3 watching steam generators (S/Gs) and feedwater. He immediately recognized that an Abnormal Operating Instruction (AOI) existed for loss of one reactor coolant pump (RCP) (EIIS Code SJ) and was reminded by the assistant shift operating supervisor (ASOS) of the procedure number. While the SOS was getting AOI-5, "Unscheduled Removal of an RCP(s) Below P-8," out, the lead reactor operator (LRO) asked him if he wanted to run the reactor back (i.e., reduce power). The SOS said "yes" and that he did not have a problem with that, but he was going to continue to assess the condition using AOI-5. He observed the ASOS running the turbine back, and the LRO was communicating but he did not listen to the details of the communications because he was preoccupied by AOI-5. The SOS did not consider it to be a problem operating with three RCPs below 35 percent power, but he knew technical specifications (TSs) would not allow this condition for very long and that the reactor would have to be shut down relatively quickly. The SOS felt comfortable with the pace of the crew and felt like the crew was communicating adequately; however, he was concentrating on AOI-5.

The ASOS was standing next to the BOP operator (who was actually manipulating the unit board breaker switches) when the unit board 2D deenergized. He was expecting the alternate feeder to close, and when it did not, he informed the LRO that he was going to lose No. 4 RCP. When

the pump tripped, the ASOS assisted the SOS in determining what procedure to utilize and then proceeded to assist the LRO in the power reduction by handling the turbine load decrease since the BOP operator immediately had to turn his attention to S/G levels and main feedwater (which were already in a transient as a result of the loss of the 2C hotwell pump due to the loss of the unit board 2D). He initiated a turbine load reduction of three percent per minute. Two main feedwater regulating valves had to be taken to the manual position. Number 4 was taken to the manual position to prevent a high-high level turbine trip, and No. 3 to prevent a low-low level reactor trip. The severity of the feedwater transient totally preoccupied the BOP operator, which essentially separated him from the actions of the rest of the crew members.

When the No. 4 RCP tripped, the LRO's immediate thought was to trip the reactor. The LRO felt a strong sense of urgency to shut down the unit quickly.

Description of Event (Continued)

This strong sense of urgency was created by training that he had previously received on response to No. 1 RCP seal failures, which stress shutting the unit down and tripping the pump within approximately 30 minutes. If the 30-minute time limit ran out before the unit was shut down, then they were trained to trip the reactor before removing the pump from service. This training led him to believe that shutting the pump down before the unit was shut down created a situation that could not be tolerated. This strong belief that the unit needed to be shut down quickly prompted him to ask the SOS if he wanted to start reducing reactor power. When the SOS responded "yes," the LRO interpreted this as SOS approval to shut down the unit as quickly as possible because he apparently believed that the SOS and the rest of the crew shared the same sense of urgency. The LRO believed that if he did not reduce power quickly, the unit was going to trip anyway on a main feedwater transient. Consequently, the LRO started driving rods while watching power, reactor coolant system (RSC) average temperature (Tavg), and RCS pressure, although watching power more than anything else. The LRO stopped inserting rods before the reactor tripped and actually had time to respond to the SOS's direction in accordance with AOI-5 to start defeating the Tavg and Delta T channels associated with Loop 4 prior to the reactor trip. The LRO did not communicate to a useful extent with the ASOS running the turbine back during the power decrease. His strong sense of urgency to reduce power quickly resulted in the RCS being cooled faster than desired. The turbine power reduction was slower than the reactor shutdown, which resulted in low-pressurizer pressure and

ultimately led to the reactor trip at 0431 EST.

During this event, the ASOS did not assume his normal role of reading the procedure and directing the actions of the licensed operators because of his preoccupation with running the turbine back which was caused by the BOP operator's preoccupation with S/G levels and main feedwater. The SOS did not assume his normal role of supervisory oversight of the transient and verification of proper operator communication and interaction because he had assumed the ASOS's normal role of procedure reader. At the time of the pump trip, the SOS believed that the reactor needed to be shut down but considered that the reactor shutdown could be handled well within the realm of a relatively routine controlled shutdown. This belief was shared by the ASOS. However, the LRO believed that the shutdown needed to occur quickly and proceeded to do so when he believed he had SOS concurrence.

This strong sense of urgency, combined with a failure to properly communicate with the ASOS on the turbine, ultimately led to the reactor trip. However, if the LRO had better watched the fundamental parameters, i.e. Tavg and reference temperature (Tref), which are indicative of reactor power-turbine power mismatches, and had attempted to keep Tavg and Tref matched, the trip may have also been avoided. Also, if the SOS had properly assumed his role of supervisory oversight, he would have likely caught the LRO's mistake and redirected him prior to the reactor trip.

Cause of Event

The cause of the reactor trip was a misunderstanding of the event by the LRO and failure to maintain Tavg and Tref during the shutdown. His sense of urgency to quickly reduce power resulted in a RCS cooldown and mismatch of the Tavg and Tref. This was a direct result of a lack of understanding of the consequences of losing one RCP below 35 percent power. However, the trip could have likely been avoided if the LRO and ASOS had been properly communicating, and if the SOS and ASOS had properly assumed their roles of overall assessment and direction. Accordingly, an additional cause of the event was deficient communication among the operating crew and inadequate command and control by the SOS, resulting in an uncoordinated effort by the operating crew. Although this event was the direct result of a single crew's actions, indications of broader weaknesses in command, control, and quality of communications have been identified.

Analysis of Event

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv) as a reactor protection system actuation that was not part of a preplanned sequence. As shown by the following discussion of plant response during and after the trip, plant systems and parameters behaved in a manner consistent with the responses described in the SQN Updated Final Safety Analysis Report (UFSAR). Consequently, it can be concluded that there were no adverse consequences to the health and safety of plant personnel or the general public as a result of this event.

The Unit 2 reactor tripped on low-pressurizer pressure approximately two and one-half minutes after No. 4 RCP tripped during a board transfer. The following assessment reviews the nonsafety-related 6.9kV unit board 2D and the response of the plant to the transient. TSs and the UFSAR, Chapters 5, 7, and 15, were reviewed for this analysis.

The loss of a single RCP below 35 percent power does not initiate a safety action; therefore, this was not included in the UFSAR analysis response.

6.9kV Unit Board 2D Has The Following Loads:

No. 4 RCP
Hotwell Pump 2C
Condenser Circulating Water Pump 2C
480V Unit Board 2B (Normal)
6.9kV Shutdown Board 2B-B (Alternate Feed)
NOTE: 6.9kV Shutdown Board was on normal feed, and thus not affected.

480V Unit Board 2B Feeds:

Condensate Demineralizer Pump 2C
Condensate Demineralizer Pump 2B
Raw Cooling Water Pump E
Control Rod Drive Motor/Generator Set 2B
Condenser Vacuum Pump 2B
Condenser Vacuum Pump 2C
Generator Bus Cooling Fan 2C
Stator Cooling Water Pump 2
S/G Blowdown Pump 2B
Turbine Seal Oil Backup Pump Electro-Hydraulic Control Fluid Pump 2B
480V Turbine Building Motor-Operated Valve Board 2B (normal feeder)
480V Turbine Buildin
Vent Board 2B

480V Transformer Yard Cab 2

The following are discussions of critical plant parameters and their transient responses.

RCS Pressure

Before the event, RCS pressure was approximately 2,237 psig. Following the loss of No. 4 RCP, pressurizer pressure rose approximately 2 psig because of reduction of primary to secondary plant heat transfer. RCS pressure then began to decrease because of the reduction of reactor power and the resulting cooldown. The low-pressurizer pressure reactor trip was received at 1,970 psig, and pressurizer pressure immediately began to recover. Pressurizer pressure was returned to 2,230 psig within 30 minutes following the trip.

RCS pressure was within TS limits at the initiation of the event and did not drop significantly below the reactor trip setpoint during the transient.

RCS Temperature

RCS temperature was approximately 554 degrees F before the event. Following the RCP trip, all four hot leg temperatures increased initially approximately 2 degrees because of decreased heat transfer to the S/Gs as a result of a decrease in RCS flow. RCS temperature then began to decrease because of reduction of reactor power. Following the reactor trip, the RCS was borated due to the Tavg dropping below 540 degrees F and auxiliary feedwater was manually controlled in accordance with Emergency Instruction (ES) 0.1, "Reactor Trip Response." The Loop 1 cold leg temperature reached a minimum value of 507 degrees F. RCS temperature stabilized at approximately 540 degrees F following the trip.

Forced and Natural Circulation

While the loss of RCP results in a partial loss of RCS flow, TS 3.4.1.1 requires the unit to be in hot standby within one hour while in Modes 1 and 2, with less than all four reactor coolant loops in service. The reactor was operated approximately three minutes before a reactor trip occurred and hot standby (Mode 3) was entered.

Feedwater Flow S/G Level

Loops 1, 2, and 3 feedwater flow decreased as expected following the trip and isolation of main feedwater. Loop No. 4 S/G level dropped sharply as a result of the rapid drop in Loop No. 4 RCS temperature following the No. 4 RCP trip. This caused an increased feedwater flow to Loop No. 4 S/G because of feedwater control valve operation. This overfeed and the lack of steaming in No. 4 S/G caused a level increase to 64 percent. Following the trip, auxiliary feedwater was manually controlled in accordance with ES-0.1 to bring the levels back to normal.

Steam Flow

Steam flow pretrip was at expected values and dropped rapidly upon the reactor trip. Flow continued to steam dumps following the trip. No adverse conditions were experienced.

Steam Pressure

Steam pressures were constant at approximately 930 psig pretrip. Following the trip, S/G pressures dropped to approximately 803 psig because of the cooldown. Pressures then slowly increased to the no-load values. No TS limits were challenged.

Shutdown Margin

Following the trip, an emergency boration of 360 gallons was performed when the Tavg decreased to less than 540 degrees F in accordance with ES-0.1. This action ensures shutdown margin was maintained during the posttrip transient. A formal shutdown margin calculation was performed within two hours following the trip to verify adequate shutdown margin. No TS limits were challenged.

Pressurizer Level

Before the loss of No. 4 RCP, pressurizer level was at approximately 33 percent and steady. At the loss of No. 4 RCP, the RCS temperature rose, and there was a surge into the pressurizer raising the level to 34 percent. With reduction of reactor power and subsequent lowering of the Tavg, RCS inventory shrank, and the pressurizer level dropped. The level was reduced to approximately 6 percent and started to recover to program setpoint after the reactor trip.

Reactor Power

Before the loss of No. 4 RCP, reactor power was approximately 30 percent. Reactor power was steady through the transient until the rods were inserted manually. At this point, reactor power was reduced rapidly to approximately 10 percent power when the reactor trip occurred.

Corrective Action

The immediate corrective action was to determine the loss or deenergization of the 6.9kV unit board, which was caused by a malfunction of the 62-224 relay. This relay was tested and cycled ten times, but the malfunction could not be duplicated. A caution order was placed on the unit board transfer switch to verify Relays 62-224 and 27T2DX are deenergized after the 6.7kV unit board 2D transfer is completed before placing the board transfer switch to automatic.

The lack of a procedure covering the loss of a RCP was corrected by revising AOI-5 to trip the reactor if an RCP trips and power is above 10 percent. This will eliminate any questions or reservations that the operator may have about trying to reduce power and regain the service of the RCP before the reactor trips.

The failure of Operations' personnel to assume their normally assigned tasks were discussed with the crew. Each crew member associated with this event was provided training and additional requalification on command and control function, proper communications, and conduct of operation. This was completed on December 15, 1990. Also, each operations crew was briefed on Plant Operations Review Committee findings before assuming their shift. This was completed on November 24, 1990.

SQN's management has initiated the following broader corrective actions to enhance and strengthen the command and control function: (A) analysis of operating personnel for qualification for roles, proper crew mix, understanding of and buy-in to management expectations, ownership of plant, and interface with Work Control and Maintenance; (B) recruitment of experienced Operations' personnel from best operating plants, and (C) review of the conduct of Operations' procedure.

This event was recreated three times on the Watts Bar Nuclear Plant simulator. Each time the unit was at 30 percent simulated power when the reactor pump No. 4 and unit board 2D were tripped. Once the recreation produced a reactor trip and this was when the control rods were placed in manual position and driven in to simulate 10 percent reactor power simultaneously with a turbine runback to 20 percent power. The other two

recreations of the event, once with the control rods in automatic and once with the control rods in manual (with no operator intervention), produced no reactor trip.

Commitment

None.

1172h

ATTACHMENT 1 TO 9012280292 PAGE 1 OF 2

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Joseph R. Bynum
Vice President, Nuclear Operations

December 21, 1990

U.S. Nuclear Regulatory Commission
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Gentlemen:

TENNESSEE VALLEY AUTHORITY - SEQUOYAH NUCLEAR PLANT UNIT 2 - DOCKET NO.
50-328 - FACILITY OPERATING LICENSE DPR-79 - LICENSEE EVENT REPORT (LER)
50-328/90017

The enclosed LER provides details concerning a Unit 2 reactor trip, which occurred on November 23, 1990. The reactor trip was caused by a low-pressurizer pressure reactor trip signal resulting from a reactor power and turbine power mismatch that occurred during a unit shutdown because of the loss of a reactor coolant pump. This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv) as an automatic reactor protection system actuation.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. R. Bynum

Enclosure
cc: See page 2

U.S. Nuclear Regulatory Commission
December 21, 1990

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